

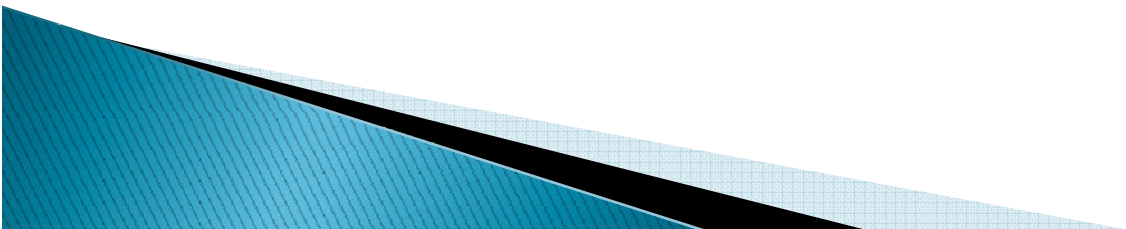
Attachment A

Nebraska Rural Independent Companies' Recommendations to Improve Regression-Based Caps

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Policy Goals for Regression Caps

1. Allocate limited universal service resources to maximize utility while maintaining equitability.
2. Establish caps that are appropriate and accurate for all companies' service areas.
3. Establish caps that will result in companies seeking the most efficient technologies.
4. Provide incentives for companies to invest in broadband-capable plant for unserved and underserved areas.



NRIC's Concerns with the FCC's Regression Methodology in the FNPRM

▶ Data Used to Develop the Regression Formula

- Additional data are needed, e.g. soils, climate, variables capturing regional cost differences.
- The mapping data is inaccurate in many cases.

▶ Regression Formula Development

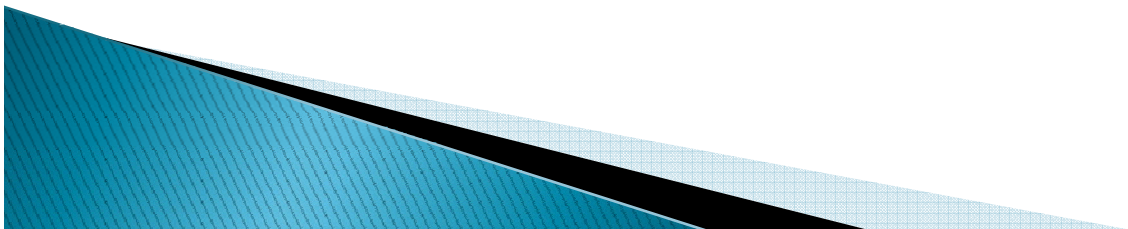
- The proposed regression equations do not include either area density or linear density; these variables have been shown to relate most closely to cost.
- Use of insignificant variables, incorrect transformations, failure to handle scale factors and inappropriate addition of a one to zero values before calculating logs – results in an equation that is not robust.

▶ Application of the Regression Formula

- Algebra errors in the computation of caps result in improperly reduced support.
- Multiple caps will not identify the least efficient companies, and will incorrectly cap efficient companies. Companies will reallocate expenses to avoid the caps. Corporate operations expense caps are handled differently than other expense caps.
- The frequency of re-establishing caps will create needless uncertainty.

Improvements to Data Used to Develop the Regression Formula—Exchange Boundaries

- ▶ Commercial databases that identify exchange boundaries have substantial data problems.
 - Inattention to known data problems will result in court challenges.
 - A regression equation is only as good as its inputs.
- ▶ The FCC can obtain more reliable exchange boundary maps.
 - Over 20 state maps can be easily obtained. Some maps are publicly available on the internet.
 - Maps may be also be available from state commissions or telecommunications associations.
- ▶ The FCC should adopt a procedure for state commissions to submit corrections to exchange boundary data.
 - Waivers are an inappropriate means to handle data errors.
 - Companies will only divulge data problems if doing so improves their results.



Improvements to Data Used to Develop the Regression Formula—Density is Omitted

- ▶ Density has long been shown to be an important predictor of costs, but is not significant in the FCC's equations.
 - NRIC's studies showed density to be an important cost predictor:
 - Linear density was the most significant predictor of capital expenditures, and area density proved to be a significant predictor of expense.
 - Marginal improvements from using linear density over area density does not overcome the difficulties in data collection and auditing.
 - Peer Reviewers agree that the equations omit critical variables:
 - “suffer from omitted variable bias...” “an alternative variable, such as the loop length, which may be a better predictor of costs” “the Appendix does not make a convincing argument that the existing explanatory variables are sufficient ...” “Existing knowledge about that production process from engineering models and studies may provide the best guidance”
 - Other commenters, Moss Adams, WITA and the Nebraska Commission, agree that density is a critical cost determinant.
- ▶ Variables derived from multiple sources, e.g. NECA and Census, may be more prone to error than those with a consistent source.

Improvements to Regression Formula

Development—Scale Problems

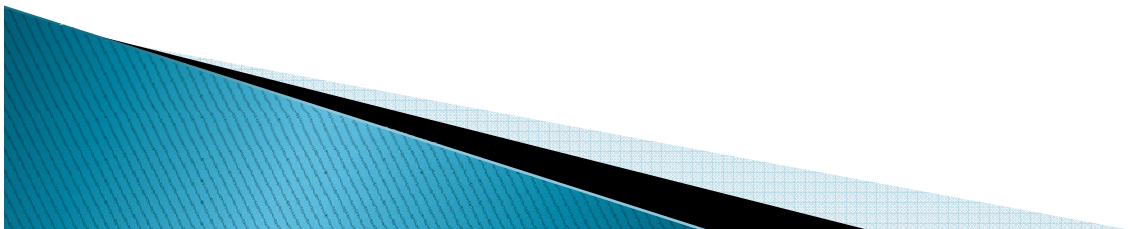
- ▶ Because the FCC's regression used a scale-dependent variable, Total Cost, the equation fails to identify the core cost drivers. Rather, the results show study areas with a large number of loops have high cost.
- ▶ The dependent variable should be Cost per Loop. NRIC found the following variables to be significantly related to Cost per Loop:

Attribute Being Measured	Independent Variable	Relationship to Cost per Loop
Density	Loops per Square Mile	Inverse
Density	Weighted Household Density	Inverse
Company Size	Loop Count	Inverse
Service Area Size	Square Miles	Inverse
"Ruralness" Indicator	$\text{CenBlk}_{\text{Non-Urban}} / \text{CenBlk}_{\text{Total}}$	Direct
"Ruralness" Indicator	$\text{Square Miles}_{\text{Non-Urban}}$	Direct
"Ruralness" Indicator	$\text{CenBlk}_{\text{Total}} / \text{Housing Units}_{\text{Total}}$	Direct
Regional Factor	Dummy Variable for Census Region	Direct
Terrain	Square Miles of Water	Direct

- ▶ Regional dummy variables may be a surrogate for terrain, cost of living or weather. Density may be more important in areas without challenging soil conditions.

Improvements to Regression Formula Development—Methodological Problems

- ▶ Insignificant variables should be excluded from regression equations.
 - Koenker: “...inclusion does inflate the variance of all the coefficient estimates and consequently does lead to some deterioration in performance of the predictions.” “there is likely to be some gain by more parsimonious model...”
- ▶ Functional forms, other than the log-log form, should be investigated.
 - Peer Reviews: “...what is it about the data that precludes the use of a linear or a log-linear specification?” “The Appendix...does not provide any evidence that this is the appropriate transformation ...” “a significant number of zero-valued independent variables and only a few zero-valued dependent variables is a clear indicator that the double log form is inappropriate.”
- ▶ The constant added to zero value variables before taking the log should be as small as possible.
 - Peer Reviews: “A related point, is the treatment of zeros values when taking logs of the dependent and independent variables.” “the value of the offset can have real consequences on the estimated conditional quantile function.”



NRIC's Best Total Loop Cost Equation Includes Density

$$\text{Total Loop Cost}_{\text{Per Year}} = A + B \times \text{LoopCount} + C \times \text{LandArea_nu} + D \times \text{WHuDen} \\ + E \times \text{WaterArea} + F \times \text{LandArea_ua} + G \times \text{NorthEast}$$

Factor	Coefficient Symbol	Coefficient	T Statistic	Standard Error
Constant	A	1,357,582	9.63	140,949.7
Total Loop Count	B	637	46.89	13.6
Non-Urban Land Area	C	186	5.93	31.4
Weighted Housing Density	D	-451	-3.06	147.5
Water Area	E	-4,998	-4.71	1,062.2
Urban Land Area	F	-3,823	-1.69	2,255.7
Dummy Variable for Northeast	G	-1,776,847	-5.24	339,243.2

- ▶ Ordinary Least Squares R-Squared = 0.77 for above equation with corporate operations expense included in the dependent variable. If corporate operations expense is excluded from total cost, the R-Squared = 0.75.
- ▶ Quantile Regression_{90th Percentile} R-Squared = 0.66 and Quantile Regression_{95th Percentile} R-Squared = 0.68 with all variables remaining significant.

NRIC's Best Cost per Loop Equation Includes Several Variables in the Inverse Form

$$\begin{aligned} \text{Annual Cost Per Loop} = & A + B \times 1/\text{LoopCt} + C \times 1/\text{WHuDen} + D \times \text{NorthEast} \\ & + E \times \text{LandArea_ua} + F \times 1/(\text{HU}/\text{BlkCt}) \\ & + G \times 1/(\text{LandArea_nu}) \end{aligned}$$

Factor	Coefficient Symbol	Coefficient	T Statistic	Standard Error
Constant	A	621	13.04	47.6
1 / Loop Count	B	289,661	21.28	13,609.7
1 / Weighted Household Density	C	5,215	2.38	2191.4
Dummy Variable for Northeast	D	-366	-3.05	119.7
Urban Land Area	E	1.30235	1.86	0.7
1 / (Housing Units/Census Blocks)	F	753	9.59	78.5
1 / (Non-Urban Land Area)	G	929	9.04	102.7

Ordinary Least Squares R-Squared Statistic = 0.55

Quantile Regression_{95th Percentile} R-Squared = 0.56 with all variables remaining significant, except 1/Weighted Household Density is replaced with Loops per Square Mile with a negative linear relationship.

Improvements to Formula Application— Apply the Correct Algebra

$$\text{SACPL} = \frac{\text{Total Unseparated Costs}}{\text{Loops}}$$

$$\text{Total Unseparated Loop Costs} = \text{Unseparated Loop Expenses} + 11.25\% \times \text{Loop Rate Base}$$

$$\text{Unseparated Loop Expenses} = (\text{Expense}_{\text{CWF}} + \text{Expense}_{\text{CWFDepr}}) \times \left(\frac{\text{Investment}_{\text{CWF Cat1}}}{\text{Investment}_{\text{CWF}}} \right)$$

$$+ (\text{Expense}_{\text{COE}} + \text{Expense}_{\text{COEDepr}}) \times \left(\frac{\text{Investment}_{\text{COE Cat4.13}}}{\text{Investment}_{\text{COE}}} \right)$$

$$+ (\text{Expense}_{\text{Various}}) \times \left(\frac{\text{Investment}_{\text{CWF Cat1}} + \text{Investment}_{\text{COE Cat4.13}}}{\text{Investment}_{\text{TPIS}}} \right)$$

$$\text{Loop Rate Base}_{\text{CWF Cat1}} = \text{Invmt}_{\text{CWF Cat1}} - \text{AccDepr\&Amort}_{\text{CWF Cat1}} - \text{DefOpIT}_{\text{CWF Cat1}} - \left(\frac{\text{Invmt}_{\text{CWF Cat1}}}{\text{Invmt}_{\text{TPIS}}} \right) \times \text{Invmt}_{\text{Mands}}$$

$$\text{Loop Rate Base}_{\text{COE Cat4.13}} = \text{Invmt}_{\text{COE Cat4.13}} - \text{AccDepr\&Amort}_{\text{COE Cat4.13}} - \text{DefOpIT}_{\text{COE Cat4.13}} - \left(\frac{\text{Invmt}_{\text{COE Cat4.13}}}{\text{Invmt}_{\text{TPIS}}} \right) \times \text{Invmt}_{\text{Mands}}$$

Notes:

1. Expense_{Various} includes Network Operations, Network Support, General Support, Corporate Operations, Operating Taxes, Rent, and Benefits excluding Corporate Operations Benefits.
2. Investment_{CWFCat1} includes Capital Leases assigned to Category 1 and Investment_{COECat4.13} includes Capital Leases assigned to Category 4.13.
3. Expense_{COE} and Expense_{CWF} exclude “Rents” and “Benefits.”

Improvements to Formula Application—When Investment is Capped, Adjust Investment in the Denominator and Adjust Accumulated Depreciation

- ▶ Under the current methodology, when AL1 and AL2 are reduced by X%, the SACPL is also reduced by X% but should be reduced by a lesser amount if appropriate adjustments were made.
- ▶ The current HCLS methodology uses particular categories of investment in the numerator of a ratio and the total investment in the denominator. It is mathematically incorrect to reduce the numerator but not the denominator. The result will be too low a ratio.
 - Even though an expense category, e.g. $Expense_{CWF}$, should be unaffected by a cap, if the related investment is capped, then the expense algorithm line will be reduced.
 - A company makes plant investments in part to decrease maintenance costs. If a company makes an investment, its investment could be capped, as well as the expenses that it was trying to reduce.
- ▶ When investment is capped, the associated accumulated depreciation should also be reduced by the same amount. Otherwise, the net rate base is too low and could be negative in the extreme.

Improvements to Formula Application— Reduce the Number of Caps

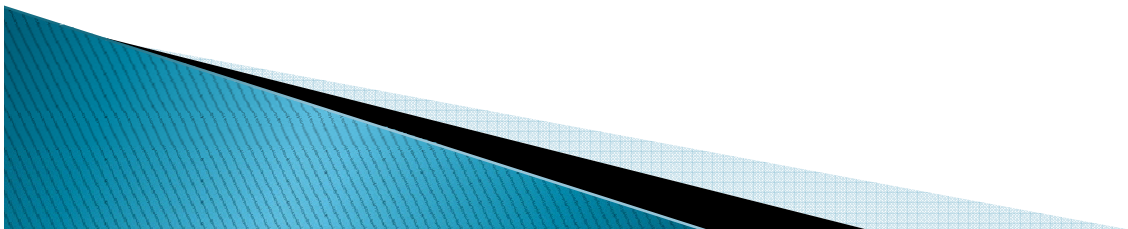
- ▶ Multiple separate caps will not lead to efficient resource deployment.
 - In order to meet each cap, a carrier's choice of technologies could be inadvertently influenced, creating a solution that may be less efficient overall.
 - Many separate caps add complexity and are less transparent, making it difficult for companies to determine what will be considered reasonable. Multiple caps creates an incentive for companies to shift expenses from one category to another.
 - The current formula caps some companies that are likely efficient, and doesn't cap other companies. 10 companies exceeded just one cap but were substantially under (<50%) the other caps. 10 companies were within 20% of four or more caps.
- ▶ Experts agree that overall costs should be used to assess efficiency.
 - Peer Reviews: "...individual cost capping ignores any complementary or substitutability between the various cost components..." "A more flexible approach may be to estimate the 90th percentile over the total costs. This would be more in line with theoretical cost-minimization approaches"
 - Koenker: "Extravagant expenditure on one cost category...is not necessarily a sign of poor overall management, or general carrier inefficiency." "...estimation of aggregate cost models via quantile regression of the same type that has been proposed for individual components does offer a simple and straightforward method of assessing individual carrier performance ..."

Improvements to Formula Application— Reduce the Number of Caps, Cont.

- ▶ HCLS caps should be applied consistently. A cap on corporate operations expense should be combined in an overall cap with all other expenses.
- ▶ Establishing caps on previous investment does not allow carriers to receive a return on lawful past investments. The FCC could apply a lower, non-zero return to investments over the 90th percentile.
- ▶ Multiple caps set at the 90th percentile individually will not mathematically result in the 90th percentile of overall costs.
 - Peer Reviews: “By disaggregating the total cost function, and estimating the cost lines separately using quantile regression, and then adding them up, assumes that the quantile of the sums equals the sum of the quantiles. ...this relationship does not hold true for quantile regressions.”
 - Koenker: “Unlike means, for which the mean of the sum of random variables is simply the sum of the means of the variables, $E(\sum Y_i) = \sum E(Y_i)$, it is not the case that sums of marginal quantiles equal the quantiles of the sum of those random variables.”
- ▶ Costs should be grouped into one (overall cost per loop) or at most two categories (expense and investment) to establish caps.

Improvements to Formula Application—Caps Should Be Set Less Frequently Than Annually

- ▶ Annual calculation of caps as proposed will produce insufficient and unpredictable support.
- ▶ As carriers constrain cost over time to avoid the 90th percentile caps, repeated recalculation of the caps will create a “destructive spiral” of more rigorous caps and declining costs.
- ▶ Regression caps should only be run periodically, such as when new Census data are available, to improve predictability and sufficiency.
- ▶ Redistribution of capped support to uncapped carriers should continue to ensure recovery of appropriate costs.



Conclusions

- ▶ NRIC encourages the FCC to take time to (a) collect additional data, (b) improve the exchange boundaries and (c) make changes to the formulas as discussed in NRIC's Comments and Replies.
 - If the FCC moves forward with a revised formula as of July 1, 2012, the formula must incorporate known cost drivers.
 - At a minimum, the multiple caps should be consolidated into one or at most two caps, the caps should be recalculated less frequently than annually, and a higher percentile should be used given the low r-squared statistics and data problems.
- ▶ Caps can be phased in by: (a) setting them at a higher percentile initially, and (b) applying a lower non-zero return to investments exceeding the cap.
- ▶ Once caps are implemented, the FCC should evaluate the effect of the caps and consider further modifications based on that evaluation.